Injection device

Technical background

Many injection devices are known which allow an inserted syringe to be positioned in such a way as to permit simple insertion into the skin, to the required depth, and injection of the medicament, without the syringe being maneuvered directly by hand. Such an injection device in every case has the purpose of improving the safety of the injection and also the handling comfort, so that injections that are often needed on a daily basis or in some cases even several times a day can be carried out independently by all patients themselves, even without specific training, which also represents a considerable saving in costs.

Prior art

Injection devices are known in which, in order to increase comfort and safety, an automatic sequence of insertion of the syringe needle and subsequent injection is carried out, for example as is known from EP 1 233 801.

FR 2 519 866 A concerns a syringe mechanism with which three different medicaments from three cartridges can be injected through coaxially arranged cannulas and to different depths. An injection carriage receives the three cartridges and is moved by an actuating element for the injection, for which purpose three plungers are used which are acted on by springs. Upon release of the actuating element, and by means of a first (outer) spring, the unit composed of actuating element with the plungers and with the injection carriage is pushed forward, the two coaxial needles are pushed out, and the insertion stroke is thus executed. One spring is tensioned counter to the direction of insertion here. Thereafter, further springs are activated, and the

medicaments present in the three cartridges are injected through the two coaxial needles, the injection stroke thus being executed. After injection has been performed, this injection device can be opened to remove the empty cartridges by means of its lower half and upper half being separated, in which process the spring pushes the needles back in order to protect them.

A disclosure of other functions of this syringe mechanism cannot be taken from the description given in said document, nor can any such disclosure be seen from the figures.

After the injection has been completed, the injection device has to be moved away from the puncture site by the patient in order to withdraw the needle. This must be done as far as possible perpendicularly in relation to the surface of the skin and with a steady hand, in order to avoid injuries from the needle. In the abovementioned devices, this is not guaranteed. On the contrary, in extreme cases, safe removal of the needle is made even more difficult by the much greater inherent weight of the injection device compared to a syringe.

DE 356 704 C discloses a structural possibility in which the needle of an injection device can also be withdrawn automatically by means of three tubes arranged in the manner of a telescope:

The insertion stroke is in this case effected by a first spring which acts on an inner tube of the syringe mechanism in which the syringe is held. After the insertion stroke, a second spring is released which is pretensioned beforehand by pulling out a toothed rod as actuating element. The released second spring effects the injection stroke by acting on the syringe plunger. Finally, a third spring is released by the movement of

the toothed rod at the end of the injection stroke, which third spring immediately drives the tubes apart again and withdraws the needle from the puncture site.

This patent specification thus describes a device which performs a controlled sequence of insertion stroke, injection stroke and return stroke, but in which the construction solution is based on separate guide elements and spring elements being provided for each stroke and being triggered in succession.

In this device, therefore, each of the three strokes is performed by what in construction terms is a substantially autonomous component group, with the important consequence that the patient also has to perform three maneuvers for tensioning the three springs, namely pulling out the inner tube (tensioning of the insertion spring), pulling out the toothed rod (tensioning of the injection spring), and pushing together the two outer tubes after the end of a cycle (tensioning of the restoring spring).

This tensioning of the three springs by separate maneuvers which are performed at different times and which require increased attentiveness on the part of the patient both before and after the injection cycle (even though the latter takes place automatically) means that the three springs have to be tensioned with chronological staggering in order to once again establish the stand-by state for a new injection cycle.

Because of the outwardly exposed toothed rod mechanism and the control elements arranged freely on the outside, for example pawl 14 and lever 15, there is also a danger of accidental, uncoordinated activation of individual strokes, with the consequence of incorrect functioning.

Therefore, despite the degree of automation of the

strokes, this previously known device can be handled only with difficulty and is therefore not suitable for everyday use by lay persons. Together with its unwieldy structure, this injection device therefore does not satisfy current demands for maximum comfort through minimal handling requirements.

FR 2 616 221 A1 likewise discloses an injection device with a succession of insertion stroke, injection stroke and return stroke which, in contrast to the abovementioned DE 356 704 C, are controlled in terms of their automatic sequence by a single, targeted linear movement of an actuating element.

In this injection device, the syringe is mounted in what is essentially a stationary guide part 20/181 for the front end of the syringe. During the course of the insertion stroke, a spring 23/123 specially inserted for the return stroke in this stationary guide part is pretensioned by the front end of the syringe, which then effects the return stroke after the end of the injection stroke.

The sleeve-shaped, stationary guide part with the inserted return spring has the disadvantage, however, that the injection device can be used only for a specific syringe format with a specific external diameter, and, in addition, quite considerable manufacturing precision must be maintained in order, on the one hand, to guarantee reliable guiding of the syringe during the insertion stroke and, on the other hand, however, to ensure that there is sufficient play to avoid jamming or wedging and, consequently, incorrect functioning of the injection device.

In both of the aforementioned injection devices, the return travel during the return stroke depends exclusively on the pretensioning of the separate return spring; this means that in order to maintain a defined

return stroke, which is intended to correspond approximately to the oppositely directed insertion stroke, a precise selection/dimensioning of the return spring is required, which once again is associated with the friction characteristics of the front part of the syringe in the stationary guide part.

The concept of the stationary guide part with the inserted return spring is therefore simple in principle, but its structural design is difficult to implement in practice and entails the risk of incorrect functioning.

Disclosure of the invention

The object of the invention is to make the handling of the injection device of the generic type easier and safer.

This object is achieved according to the features of claim 1.

The invention thus makes available an injection device which, by means of a single, targeted linear movement, inserts the needle to a defined depth, injects the medicament and, once the injection has been completed, produces a return stroke, which withdraws the needle into the housing and thus out from the puncture site. The drive force for the linear movement can be produced manually, either directly or by intercalation of energy accumulators. For a defined return movement of the syringe, an additional carriage is used which is arranged functionally between actuating element and injection carriage.

Therefore, the difference from the technical teaching of DE 356 704 C is to be seen in the selection and relationship of the component parts which, in particular, allow the patient to perform the entire

actuating work for the entire process with just one hand, the injection device thus forming an "integrated" structural unit.

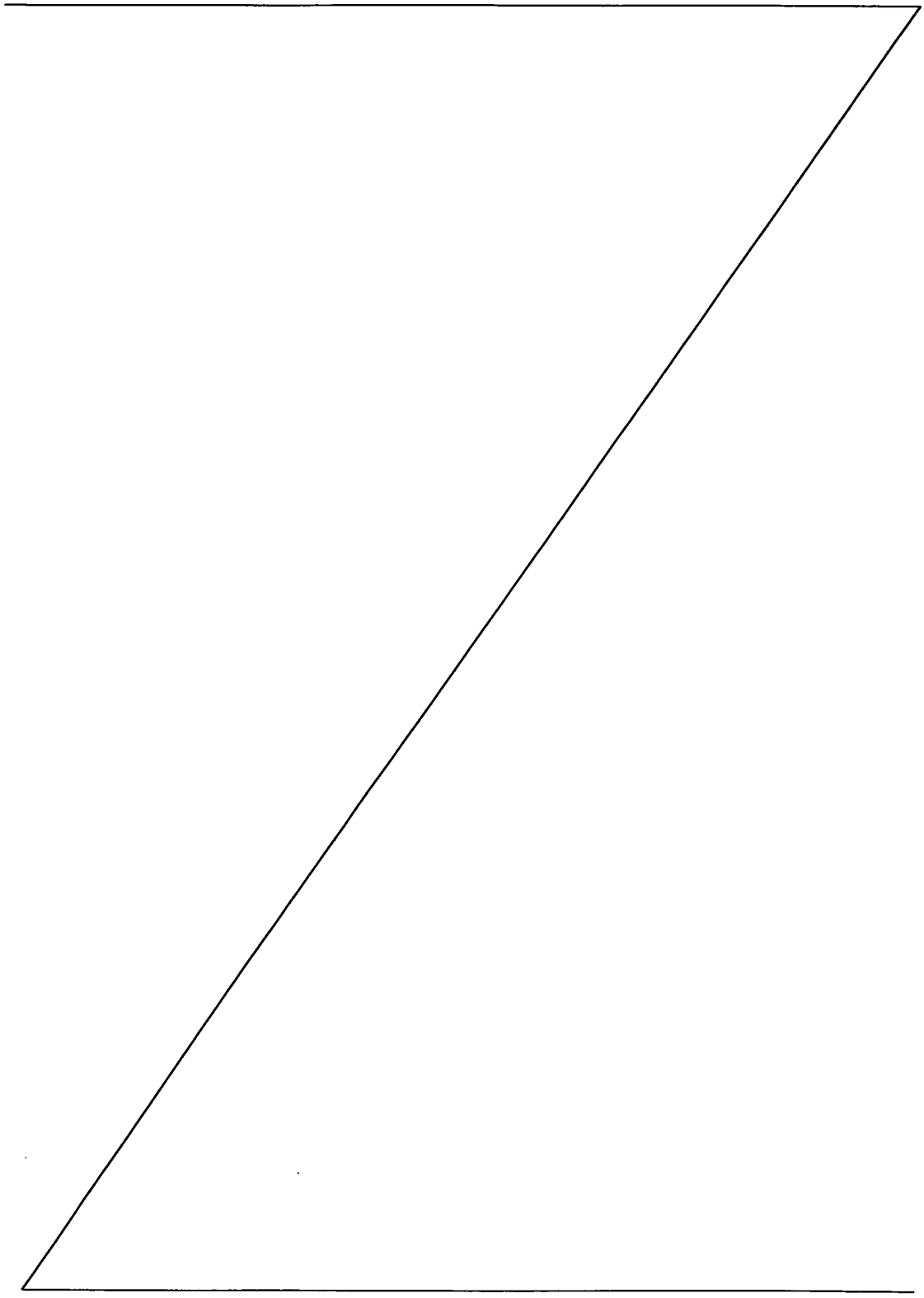
The difference from the technical teaching of the generic FR-A-2 616 221 and of DE 356 704 C is to be seen in the fact that the syringe is guided in the return stroke by a carriage component which does not require any adaptation to the syringe diameter. The guide device used is exclusively a syringe holder which is part of the injection carriage and which ensures an exact control of the path of the return stroke, without interaction of a return spring which is mounted in a cylindrical guide device and acts on the front of the syringe and which is associated with mechanical and dynamic imponderables in the return stroke.

An acoustic signal can be generated at the end of the return stroke. Following this acoustic signal, the patient can lift the entire injection device away from the injection site without special precaution or attention, because the needle has been withdrawn from the insertion site.

After the injection has been completed, the needle does not protrude from the injection device, and for this reason there is also no longer any risk of injury when handling the injection device after the injection.

If the protective cap is removed following insertion of the syringe, and if the protective cap is put back on again after the injection procedure, and before removal of the syringe, then the patient at no time sees the needle, neither before nor after the injection, in the case of a prefilled syringe, a fact which facilitates handling of the injection device, particularly for those patients who suffer from what is called "needle phobia".

Advantageous developments of the injection device according to the invention are set forth in the dependent claims.



Patent claims

1. An injection device for a syringe, having a syringe body, a cannula with a needle, and a plunger with a plunger rod, and having at least one actuating element (120, 220, 320) for converting the actuating work, to be performed manually by the patient, into a displacement of the syringe body (101, 201, 301) during an insertion stroke (H1) and a return stroke (H3), and into a displacement of the plunger rod during an injection stroke (H2), with a guide device in which the syringe body (101, 201, 301) is mounted, and with a ram (150, 250, 350) which can be displaced against this in order to displace the plunger rod, and where the actuating work, by means of a single, targeted linear movement of the actuating element (120, 220, 320), is converted into the insertion stroke (H1), the injection stroke (H2) and the return stroke (H3) in such a way that the guide device and the ram (150, 250, 350) are acted on jointly by the actuating element in the insertion stroke (H1) and in such a way that only the ram (150, 250, 350) is acted on in the injection stroke (H2), characterized in that the guide device includes a displaceable syringe holder (140, 240, 340) in which the syringe (100, 200, 300, 400) is fixed and which is coupled releasably to the ram (150, 250, 350) and is part of an injection carriage, and, in order to perform a return stroke (H3) corresponding in magnitude substantially to the insertion stroke (H1), the actuating element (120, 220, 320, 420) acts on the injection carriage in a positionally and directionally defined manner by means of locking and coupling elements with intercalation of a further carriage (114A, 260, 323, 423).

2. The injection device as claimed in claim 1,

characterized in that the actuating element is a push rod (120, 220) which is guided parallel to the injection carriage in a housing (110, 210) and by means of which, when it is pushed into the housing (110, 210), the components for producing the return stroke (H3) are also activated.

3. The injection device as claimed in claim 2, characterized in that the components for producing the return stroke (H3) include at least one toothed wheel (113) which engages in the injection carriage (140, 150) and in the push rod (120) and which is mounted in a carriage (114A) displaceable in the housing (110), and in that the toothed wheel (113) cooperates with a blocking element which blocks the toothed wheel (113), when insertion stroke (H1) and injection stroke (H2) are performed, and which thereafter releases the toothed wheel (113), as a result of which the linear movement of the push rod (120) is converted into the oppositely directed return stroke (H3) of the injection carriage (140, 150).

4. The injection device as claimed in claim 3, characterized in that at least two toothed wheels (113A, 113B) for converting the linear movement of the push rod (120) into the return stroke (H3) are provided in the common carriage (114A).

5. The injection device as claimed in claim 3, characterized in that the blocking element is a pawl (114) which is linearly displaceable on the carriage (114A) and which, in the blocking position, engages in the teeth of the toothed wheel (113).

6. The injection device as claimed in claim 3, characterized in that the blocking element is a pivot lever (114B) which, in the blocking

position, engages in the teeth of the push rod (120).

7. The injection device as claimed in claim 2, characterized in that the coupling between syringe holder (140) and ram (150) is effected by two slide blocks (145A, 145B) which can be brought into a releasable positive engagement between syringe holder (140) and housing (110), and between syringe holder (140) and ram (150).

8. The injection device as claimed in claim 2, characterized in that the coupling between syringe holder (140) and ram (150) is effected by a further toothed wheel (113C) which is likewise held in the carriage (114A) and which is blocked during the insertion stroke (H1).

9. The injection device as claimed in claim 2, characterized in that the components for producing the return stroke (H3) include at least one spring element (261A, 261B) as energy accumulator which, before the start of the injection, is pretensioned by the push rod (220) (tensioning stroke) and, after the injection stroke (H2), is released, in order to produce the return stroke (H3) by acting abruptly on a return carriage (260) which is releasably connected to the injection carriage and which bears on the syringe holder (240).

10. The injection device as claimed in claim 2, characterized in that a rotatably mounted control lever (221) is provided in the push rod (220), one end of this control lever (221) engaging in the injection carriage (240, 250) when the tensioning stroke has been completed.

11. The injection device as claimed in claim 10, characterized in that the control lever (221), by

turning about a control angle, also effects the release of the coupling between syringe holder (240) and ram (250) at the transition from the insertion stroke (H1) to the injection stroke (H2).

12. The injection device as claimed in claim 9, characterized in that the return carriage (260) has pincer-like locking elements (262A, 262B) which, after the injection stroke (H2), engage in recesses (226A, 226B) of the push rod (220) and release the return stroke (H3).

13. The injection device as claimed in claim 1, characterized in that the actuating element includes a pull-out loading bar (320) which, when pulled out from the housing (310), pretensions at least one advancer spring (324) as energy accumulator, and a trigger mechanism (370) which, after activation, releases the injection carriage (340, 350) acted upon by the advancer spring (324) via an advancer carriage (323) for automatic execution of insertion stroke (H1), injection stroke (H2) and return stroke (H3).

14. The injection device as claimed in claim 13, characterized in that the pull-out loading bar (320), after it has been pulled out from the housing (310), pretensions at least one restoring spring (325) as energy accumulator for automatic return of the pull-out loading bar (320).

15. The injection device as claimed in claim 13, characterized in that the advancer spring (324) and the restoring springs (325) are scroll springs.

16. The injection device as claimed in claim 14, characterized in that the trigger mechanism (370)

is coupled to at least one safety element (371) which in particular permits triggering only when the injection device is placed on the insertion site.

17. The injection device as claimed in claim 13, characterized in that pull-out loading bar (320), advancer springs (324, 325), injection carriage (340, 350) and advancer carriage (323) are held in a receiving frame (312) in such a way that they can be displaced parallel to one another.

18. The injection device as claimed in one of the preceding claims, characterized in that, in order to control the processes, in particular the sequence of insertion stroke (H1), injection stroke (H2) and return stroke (H3), control elements that can be brought into and out of positive/frictional engagement with one another are provided, in particular on the actuating element (120, 220, 320), on the syringe holder (140, 240, 340), on the ram (150, 250, 350) and on the housing (110, 210) or receiving frame (312).

19. The injection device as claimed in claim 18, characterized in that the control elements include elastic sections, locking cams, slide-on planes and cutouts.

20. The injection device as claimed in claim 13, characterized in that, in order to pretension the advancer spring (424), the pull-out loading bar is replaced by a pull-out loading wire (420), one end of which has a grip (420B) on an end of the housing (410), and which has a carrier (420A) which is connected to the advancer spring (424) and engages on the advancer carriage (423) when the grip (420B) is pulled out.

21. The injection device as claimed in claims 14 and 20, characterized in that the pretensioning of the restoring spring (425) likewise takes place via the grip (420B) and the pull-out loading wire (420), as a result of which the pull-out loading wire (420) is pulled into the housing (410) until it abuts against the grip (420B) on the housing (410).

22. The injection device as claimed in claims 20 and 21, characterized in that advancer spring (424) and restoring spring (425) are designed as helical springs, one end of which is secured in a frame (412) held in the housing (410), and the other end of which is connected to the pull-out loading wire (420) either directly or via the carrier (420A).

23. The injection device as claimed in claim 22, characterized in that the other end of the pull-out loading wire (420) is connected to a receiving frame (412) held in the housing and is guided over at least one pull roller (420D) on whose shaft the other end of the restoring spring (425) is held, so that the tensile force applied by the restoring spring (425) on the pull-out loading wire (420) corresponds according to the number of pull rollers (420D) only to a fraction of the spring force of the restoring spring (425) (first pulley block).

24. The injection device as claimed in claim 23, characterized in that the advancer spring (424) is connected to the receiving frame (412) via a traction wire (424B) which is guided over at least one pull roller (424D) on whose shaft the other end of the advancer spring (424) is held, so that the tensile force applied by the advancer spring (424) to the traction wire (424B) and thus to the advancer carriage (424D) is only a fraction of the

spring force of the advancer spring (424) (second pulley block).

25. The injection device as claimed in claim 1, characterized in that a damping unit (492) is assigned to the actuating element and/or to the injection carriage (440, 450).

26. The injection device as claimed in claim 1, characterized in that additional components are provided which produce a time delay (TV) between the completion of the injection procedure and the start of the return stroke (H3).

27. The injection device as claimed in claim 26, characterized in that the additional components cancel the frictional coupling between ram (450) and advancer carriage (423) as the advancer carriage (423) continues to move for the duration of the time delay (TV).

28. The injection device as claimed in claim 27, characterized in that the duration of the time delay (TV) is adjustable.

29. The injection device as claimed in claim 1, characterized in that a volume adapter (410) can be inserted into the ram (450) and predetermines the injection stroke (H2) and thus the quantity of a medicament that is administered during the injection stroke (H2).

30. The injection device as claimed in claims 13, 20 and 26, characterized in that at least two toothed wheels mounted in a carriage (414, 415) and belonging to a pair of toothed wheels (413, 513) for gearing up or gearing down between the linear movement of the carriage (414, 514) and of the advancer carriage (423) are provided, on which at

least one spring element engages for producing the strokes (H1, H2, H3) and the time delay (TV).

31. The injection device as claimed in claim 30, characterized in that the advancer carriage (423) is formed by a toothed belt (523).